Capacity fading of Lithium Manganese Oxide positive electrode in high temperature storage

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Introduction

We have developed Lithium Manganese Oxide (Spinel) positive electrode for EV battery. A battery using Lithium Manganese Oxide (LMO) has the advantages over a low cost, environmental friendliness and safety. Capacity fading during storage at elevated temperature, however, is remarkable. It is suggested that the battery using LMO has a poor storage performance caused by manganese dissolution and distortion of crystal lattice due to the Jahn-Teller effect. We have found that the capacity fading of LMO has been gotten particularity during storage at 20% state of charge (SOC)[(1)]. Herein, we report the structure change and magnetic properties of LMO in the case of before and after storage.

Experimental

The electrochemical measurement was carried out using 17500 cell (Cell type A) which was consisted of LMO cathode, graphite anode and electrolyte (EC/DMC, 1.5M LiPF6). The charge / discharge was carried out at 0.2C, 3V-4.3V cut off. The batteries of Cell type A was charged into various SOC respectively. After storage at 60℃ for 20 days their charge/discharge capacities were measured again. LMO electrodes from Cell type A after storage were reconstructed with Li metal anode (Cell type B), and their charge/discharge capacities were measured. LMO were characterized by XRD with CuK α . Magnetic susceptibility was measured by SQUID at 5-300K.

Result and Discussion

Figure 1 shows the relationship between SOC and capacity fading. We found that capacity fading is highly dependent on the SOC in Cell type A and also Cell type B. The maximum capacity fading was obtained at 20% SOC as shown in Figure 1. It is obvious the maximum capacity fading at 20% SOC was derived from the fading of positive electrode.

The changes between before and after storage of the Full width of half maximum (FWHM) (400) obtained by XRD measurement of LMO are shown in Figure 2. By the way, the peak (400) belong space group Fd3m. The maximum capacity fading at 20% SOC is caused by structural degradation corresponding to the large change of FWHM at 20% SOC. Magnetic susceptibility versus temperature are shown in Figure 3. The magnetic susceptibility of LMO after storage at 20% SOC increases remarkably at typical low temperature. It is found that the LMO at 20% SOC is easily changeable structural and magnetically by being storage at high temperature such as 60℃. It is impossible to make clear the only idea that typical storage fading of LMO is caused by distortion of the crystal lattice due to the Jahn-Teller derived from existing Mn3+. We are proceeding with the advanced study about the LMO fading mechanism after storage.

Reference

(1) T.Hatanaka et al The 41st Battery Symposium in Japan No. 2D-09

Acknowledgement

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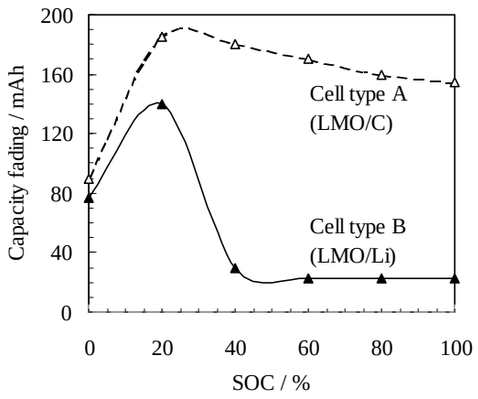

Fig.1 Capacity fading after storage at 60℃ for 20days in various SOC

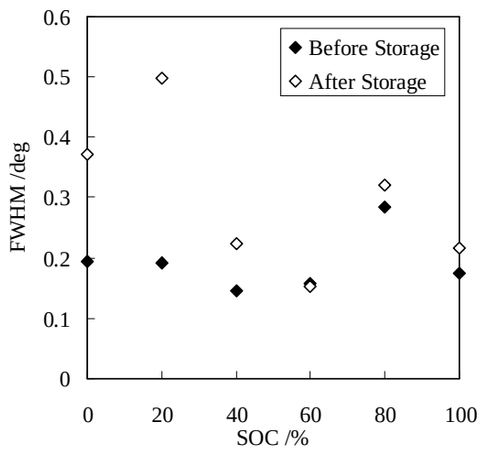

Fig.2 FWHM of the peak (400) on XRD for LMO in various SOC

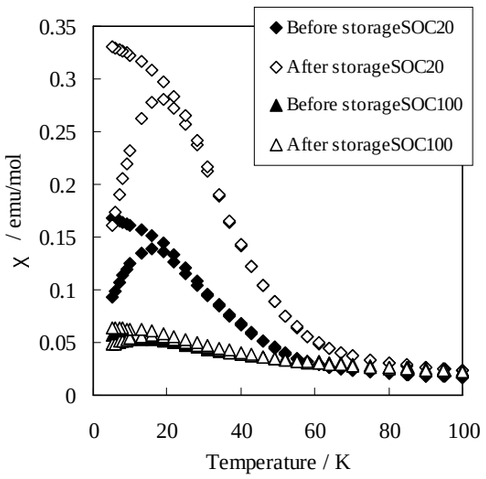

Fig.3 Magnetic susceptibility for various LMO